

13.

Notes on the Behavior and Morphology of Some
West Indian Plectognath Fishes.

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(Plates I & II; Text-figures 1-7).

A sizable fraction of the West Indian fish fauna comprises some 39 species of the Order Plectognathi. The deep sea triacanthids and the pelagic molids are infrequently reported, but the monacanthids, balistids, ostraciids, diodontids, tetraodontids and canthigasters are abundant in the bays and around the reefs, where they can be observed in their natural habitat and readily collected. During August and September of 1948 and February and March of 1949, the author had the opportunity of using the facilities of the Lerner Marine Laboratory of the American Museum of Natural History at Bimini, Bahama Islands, B.W.I., in making a study of the plectognaths of the area. The fish were obtained by dredging, seining, setting traps, hook and line fishing, and by dip-net fishing in floating *Sargassum*. Also, a number of young and larval forms were collected in plankton nets. Many of the fish were kept alive in large outdoor pens, concrete tanks and indoor aquaria where their behavior could be observed.

The author is indebted to Dr. Charles M. Breder Jr., Director of the Lerner Marine Laboratory, for many helpful suggestions.

***Balistes vetula* Linnaeus.**

More than 100 adults were maintained in the outdoor pens and concrete tanks at the laboratory. Most of these fish had been caught by hook and line and in traps. In the large outdoor pens, usually one or more of these fish were noticed resting on their sides on the sandy bottom. One might maintain this pose for as long as a minute and then suddenly right itself and swim off, apparently in good condition. At night many of these fish, which apparently were normal and healthy, were seen resting or "sleeping" in a vertical or nearly vertical position against a side wall or in a corner of their container, or lying flat on their sides on the bottom. Fish kept in smaller concrete tanks readily roll onto their side if an object is waved over the surface of the water, which apparently facilitates a better view for the observed as well as the observer.

***Melichthys piceus* (Poey).**

This species is common around the reefs south of Bimini and is easily recognized by

the light blue lines at the base of the second dorsal and anal fins and near the posterior margin of the caudal fin, these lines standing out against the otherwise dark body and fins. More than sixty adults caught in traps and on hook and line were kept in the laboratory's live collection. While swimming undisturbed, the body is usually a blue-black color, but when the fish are handled out of water this changes to a dark green with some orange on the sides of the head.

At night, like *B. vetula* many of these fish rest against the sides and bottom of their container in nearly vertical positions.

***Monacanthus ciliatus* (Mitchill).**

This species was obtained in large numbers by dredging through *Thalassia* in the shallow water off the laboratory dock. Thirteen young specimens ranging from 14 to 28 mm. were collected in *Sargassum*. At these stages *M. ciliatus* is difficult to distinguish from *Stephanolepis hispidus* (Linnaeus). However, no adults of *S. hispidus* were collected and the occurrence of *S. hispidus* in this area is questionable. It is probable that these young are all *M. ciliatus*. One 28 mm. young showed a slight enlargement of scales on the caudal peduncle. The others, 14 to 24 mm., showed no sign of this scale modification. In late August several of these young fish were kept alive and at night showed locomotor disorganization in response to light described by Breder & Harris (see Breder, 1942).

Sexual dimorphism has been reported in several species of plectognath fishes (Fraser-Brunner, 1940a, 1940b). In *M. ciliatus* there is a marked sexual difference which has not been previously recognized. It is believed that the female has often been misidentified as a small *S. hispidus*, since these two species are separated in most keys (Jordan & Evermann, 1896-1900; Evermann & Marsh, 1902; Breder, 1929; Beebe & Tee-Van, 1933) by the size and shape of the ventral flap, a difference found between the sexes of *M. ciliatus* (Text-fig. 1) as will be seen in the following analysis of the sexual dimorphism in this species.

The sexes determined by examination of

78 adults (33 males and 45 females) were found to differ in the following respects:

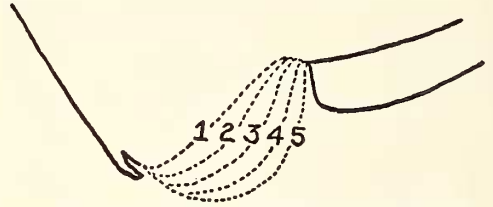
1. The males have from three to eight (usually four) well-developed recurved spines on each side of the caudal peduncle. The females lack spines but in their place have enlarged scales which sometimes bear a small straight spinule. *S. hispidus* does not have this scale modification on the caudal peduncle in either sex.

2. The males have a clear, dark, fine line near the margin of the ventral flap which is completely lacking in the females and immature fish. Specimens preserved in formalin retain this line.

3. The spread of the male ventral flap is on the whole much greater than that of the female. The spread was measured from the tip of the pelvic spine to the anus while the ventral flap was pulled out to its maximum. This length divided by the length of the snout (measured from the anterior margin of the eye to the opening of the mouth) gave values ranging from 1.3 to 2.6 with an average of 1.8 for the males and a range of 0.9 to 1.7 with an average of 1.2 for the females. These measurements were taken on specimens preserved in 10% formalin for less than two hours and are slightly lower than for living material. More than 100 specimens of

S. hispidus examined in the fish collection of the American Museum of Natural History, taken from other parts of the West Indies and Florida and ranging from 45 to 202 mm., gave comparative values from 0.5 to 0.9 (averaging 0.6). In many cases the flaps of these long-time preserved specimens were tightly folded and could not be pulled out. In some of the larger fish the flap spread might easily be equal to the length of the snout although in no case did the flap margin extend beyond the ventral spine as in types 2, 3, 4, and 5 in Text-fig. 2.

4. The margin of the ventral flap in the males is a bright golden yellow whereas in the females it is a dull, pale, greenish-yellow.



TEXT-FIG. 2. Diagram of the expansible ventral flap of *Monacanthus ciliatus* with dotted lines showing five arbitrary posterior margins (see text).

5. In the males, the ventral flap extends more posteriorly to the pelvic spine than it does in the females. Text-fig. 2 shows a diagram of a semi-expanded ventral flap with five arbitrary margins indicated by the numbers one to five according to the degree of posterior extension. In types 3, 4, and 5, the anus is well inside a "pseudocloaca" as described for *Triodon* (Breder & Clark, 1947), though not quite as pronounced.

The specimens were all classified as closely as possible under these five types of ventral flap margins. The average male had a type 4 margin and the average female a type 2. The percentage of males and females falling into these artificial groups are as follows:

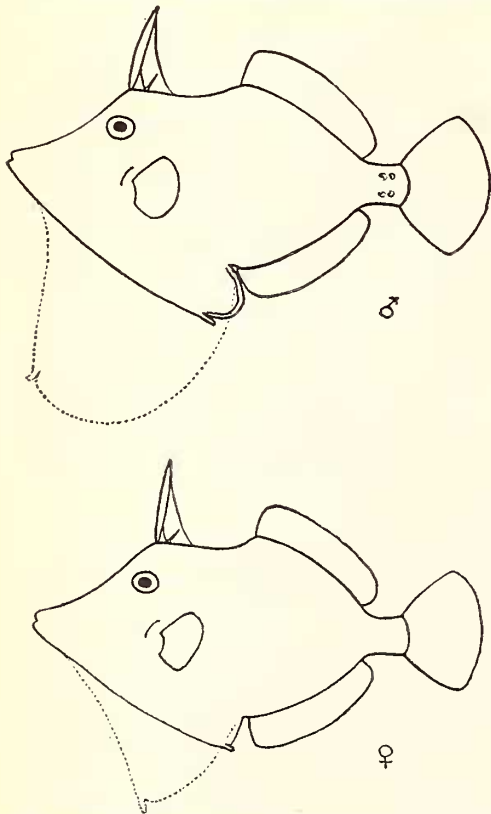
Type of flap margin	1	2	3	4	5
Percentage of males	0	0	15.2	51.4	33.4
Percentage of females	35.6	46.6	17.8	0	0

The large percentage of females with a type 1 flap shows that the extension of the flap beyond the ventral spine is not a reliable character to separate this species from *S. hispidus*.¹

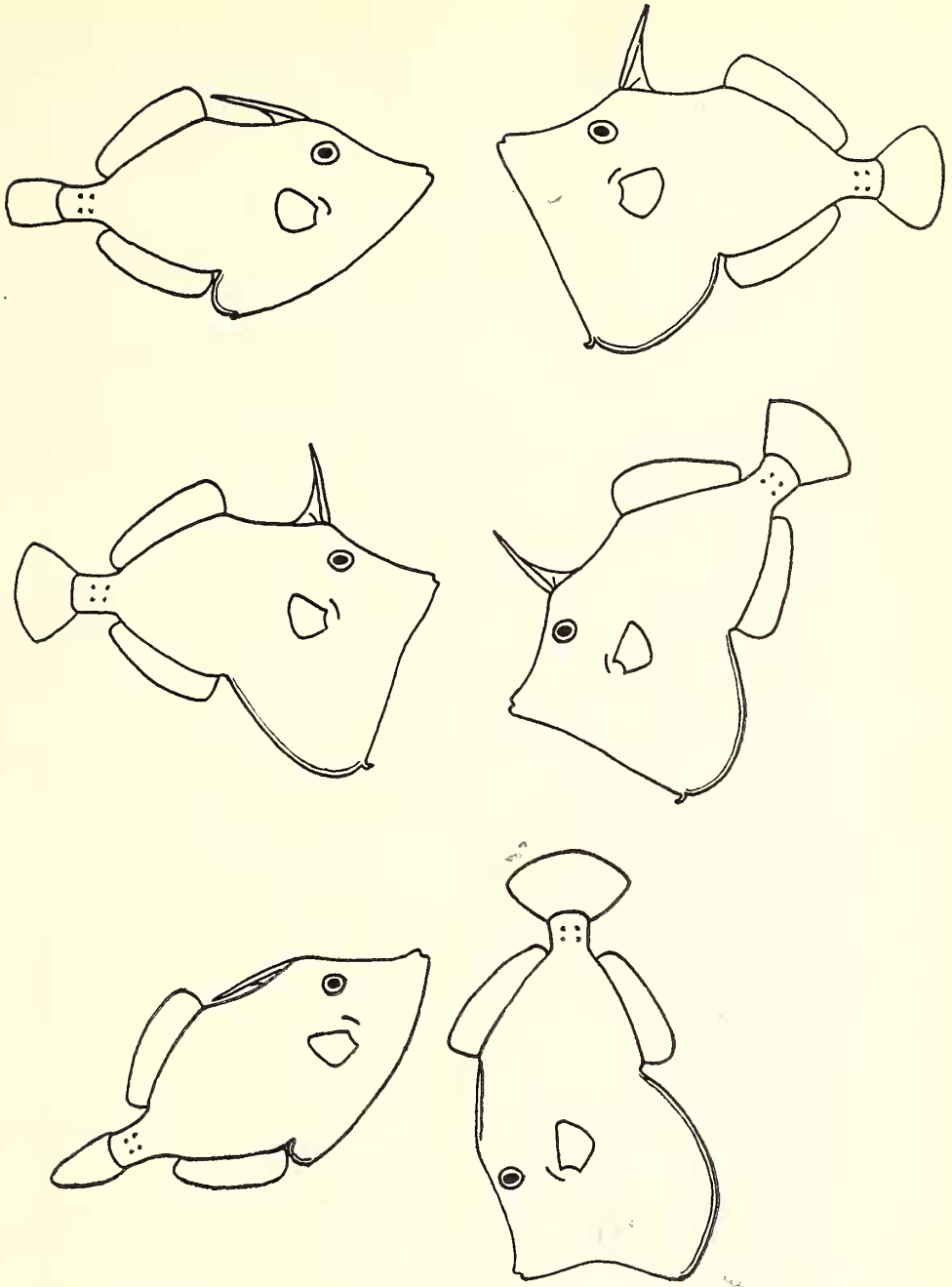
6. The males on the average are larger than the females. The average standard length of the males was 64.5 mm., ranging from 58 to 76 mm., and for the females was 55.7, ranging from 43 to 71 mm.

Several isolated individuals, male and female pairs, and five groupings of four fish each, varying in sexual make-up, were kept in 15-gallon aquaria and their behavior was followed daily for a period of several weeks during August and September. A linear hier-

¹ The scale difference between *Monacanthus* and *Stephanolepis* (Fraser-Brunner, 1941), is a more reliable character for identification purposes.



TEXT-FIG. 1. Diagrammatic sketches of a male and female *Monacanthus ciliatus* showing sexual dimorphism. The dotted lines indicate the extent of the ventral flap when fully spread.



TEXT-FIG. 3. Top to bottom illustrates three stages in an encounter between two males of *Monacanthus ciliatus*. The dominant fish is shown on the right. Note the changes in the first dorsal and caudal fins, the ventral flap, and the angle of the long axis of the body. Due to the oval pupil, the gyroscopic action of the eyeball can be easily seen as the dominant fish goes into the "head stand" position.

archical order was usually noticeable in homosexual groupings and among the more numerous sex in heterosexual groups (i.e., one male and three females or three males and one female), but was not evident when equal numbers of each sex were present.

The dominant-subordinate relationship in these fishes is evident from several of their

behavior patterns. The one most frequently observed is the sudden dashing of one fish at another. The subordinate fish swims away quickly, or may retreat to a corner, or turn over on its side and lie down on the bottom of the aquarium. The last two responses are given mostly by fishes low in an established hierarchical system. This aggressive behav-

ior appears to be the same as that noted in the "drive-order" of sunfish (Greenberg, 1947). Sometimes the dominant fish actually makes a sharp "nip" or peck at another fish—a common behavior used as a dominance criterion in studying fish hierarchies (Brad-dock, 1945, 1949; Breder, 1948). Occasionally these fish are seen nibbling at each other, especially at the opposite sex, but this gentle act, distinct from the sharp nip, does not appear to be part of the aggressive behavior indicative of the "nip-order."

The most violent aggressive behavior is a "tail slap." With a fast snap-like movement of the body, the dominant fish, after chasing and closely sidling its subordinate, flips its caudal peduncle (which in the male is armed with spines) at the other fish. Tail slapping has been observed in cichlid fishes (Noble & Curtis, 1939; Aronson, 1949) as part of a courtship pattern.

A rather spectacular behavior exhibited by *M. ciliatus* (especially males) involves the expansible ventral flap. The fish "noses down" until the long axis of the body is in a vertical position and the pelvic bone is swung forward until the flap behind it is fully expanded. The whole body appears stretched and tensed and quivering movements may accompany this posture. The caudal fin is expanded, but the dorsal spine is usually folded down against the back while the jointed pelvic spine may be either bent outward at a 90° angle or remain flush with the pelvic bone. This behavior occurs most frequently between members of the same sex and is usually started by the dominant fish (Text-fig. 3). During this act a noticeable color change takes place in the males. The body takes on more of a yellow color, especially the dorsal, anal and caudal fins, snout and ventral flap.

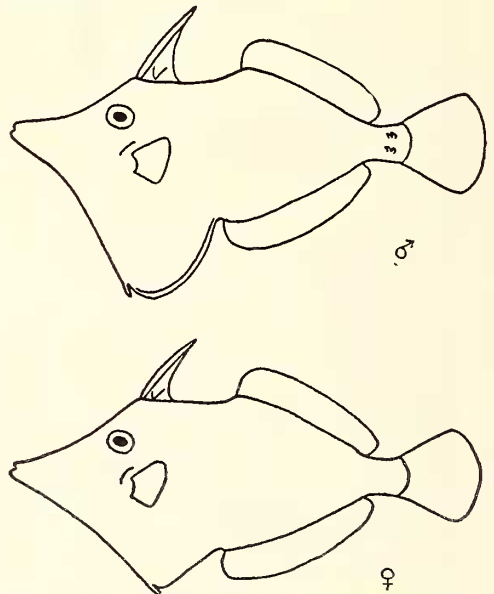
Monacanthids are occasionally observed standing on their heads in a vertical position (Longley & Hildebrand, 1941), in some cases with their noses on the ground, closely resembling an aquatic plant (Beebe, 1928; Breder, 1949). *M. ciliatus* frequently assumes a head-stand position when feeding from the bottom of an aquarium or when resting at night. It is also not uncommon for them to expand and then refold the ventral flap while swimming about apparently undisturbed even when no other fish are present. The combination of the head-stand position with the ventral flap expansion in the characteristic manner described above, however, is quite definitely associated with social behavior. Males sometimes behave in this manner before a female but more often the behavior was observed as part of an intra-sexual aggressive pattern which included nipping and tail slapping.

In each group with an established "nip-order," the *omega* fish usually remained practically motionless in a corner or lay on its side on the bottom of the tank. The fins eventually became badly frayed and in two instances the fish died, undoubtedly as a re-

sult of the frequent attacks of the other fish. The *omega* fish was palest in color, almost white, whereas the most dominant fish stood out as the darkest in each group, its body being mostly a deep greenish-brown. This correlation between darkness of coloration and dominance has been noted intra- and inter-specifically in other fishes (Greenberg, 1947; Breder, 1948).

Monacanthus tuckerii Bean.

Four adults (3 males and 1 female), ranging from 39 to 60 mm., and nine immature specimens, ranging from 17 to 30 mm., were collected by dredging through *Thalassia* in shallow water off the laboratory dock and by dip net fishing in Sargasso weed. As in *M. ciliatus* the caudal spines, ventral flap size, color and marginal stripe indicate sexual dimorphism in the four adults examined (see Text-fig. 4). Data on this material are listed in Table I.



TEXT-FIG. 4. Diagrammatic sketches of a male and female *Monacanthus tuckerii* showing sexual dimorphism.

The pectoral fin ray count was 11 for all specimens except the two larger males, for which it was 12. The caudal fin ray count for all was 12.

The color of the males was a variable brown but usually with the upper half of the body darker than the lower parts. Usually a dark brown stripe along mid-side extended from just behind the gill opening on to the caudal fin. The whole body was covered with a light network of irregular lines. A sharp white line running along the mid-dorsal line extended from the mouth to the tail and was slightly broader between the eyes. The margin of the flap (unlike that of the female) is a golden yellow with a fine blue line near the edge. Scattered brown spots and suggestions of irregular vertical bands show up in the darker color phases.

TABLE I.

Measurements and External Sex Characters of *Monacanthus tuckerii*.

Sex	Standard length (mm.)	Dorsal fin count	Anal fin count	Caudal spines	Marginal stripe on flap	Ratio of flap spread to length of snout
♂	60	II-36	35	well devel.	present	1.3
♂	59	34	35	well devel.	present	1.4
♂	39	33	33	small	present	1.3
♀	45	34	34	absent	absent	0.8
—	30	33	33	absent	absent	0.9
—	30	34	33	absent	absent	0.7
—	28	34	33	absent	absent	0.8
—	24	36	36	absent	absent	0.7
—	23	35	34	absent	absent	0.8
—	22	34	34	absent	absent	0.7
—	21	34	34	absent	absent	0.7
—	20	33	33	absent	absent	0.5
—	17	35	34	absent	absent	0.3

As in *M. ciliatus*, in late August some of the immature fish of this species (20 to 24 mm.) showed locomotor disorganization in response to sudden light.

***Cantherines pullus* (Ranzani).**

Two immature specimens were collected in floating *Sargassum* and eleven adults were caught in traps near the laboratory dock. Data on these specimens—plus one museum specimen collected in Bimini on July 19, 1937 (AMNH No. 15164), indicated with an asterisk—are given in Table II to show the variation in fin count and the tendency to larger size of the males.

TABLE II.

Measurements of *Cantherines pullus*.

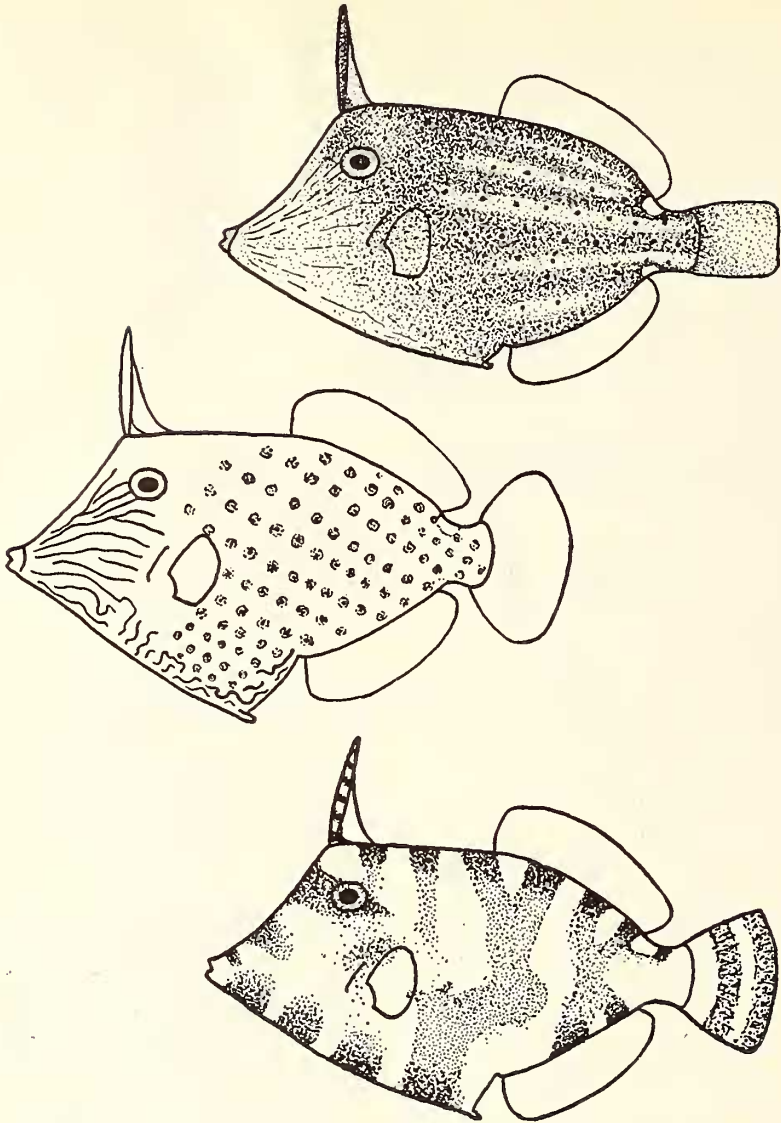
Standard length (mm.)	Sex	Dorsal fin count	Anal fin count	Pectoral fin count
32	—	II-34	30	13
38	—	35	32	13
111	♀	34	31	13
113	♀	34	30	13
116	♂	34	31	13
124	♂	34	30	13
125	♀	34	32	13
131	♂	36	31	13
132	♀	35	31	13
134	♂	34	30	13
137	♂	37	33	13
140	♂	35	31	14
143	♂	34	30	15
*148	♂	36	31	13

Spines are not present on the caudal peduncle of any of these specimens. The young have been considered as a separate species, *C. amphioxys* (Cope), by most taxonomists. Although several authors have suspected the relationship, only Longley (1933) has correctly placed them in synonymy.

All the specimens collected were kept alive and color notes were taken. The 32 mm. specimen was a uniform silvery color and never showed markings or color variations. The 38 mm. specimen, practically identical with the figures for *Pseudomonacanthus amphioxys* (Parr, 1930), had a golden metallic sheen, brightest on tail, which sometimes faded to a dull white. The color pattern of

this specimen varied somewhat, but usually dark brown areas were present which formed four irregular horizontal stripes on the posterior two-thirds of the body, the lowest not extending onto the caudal peduncle and the middle two forking anteriorly. Each stripe contained a row of regularly spaced dark spots. The head was without markings. A white spot on the mid-dorsal line just posterior to the second dorsal fin and just above the uppermost horizontal stripe, a good "field mark" in the adults previously not noted in descriptions of *C. amphioxys*, was conspicuous most of the time in this young specimen. Except for slight fading, these markings remained essentially the same after five months in 10% formalin, save the white spot, which darkened.

The adult specimens show remarkable color pattern changes which appear to be correlated more with the psychological and physiological state of the fish than with its background. Three rather distinct color phases (although sometimes overlapping) will be described: the horizontally striped phase, the spotted phase and the vertically banded phase. The first of these was seen when the adults were observed swimming undisturbed in aquaria and in the ocean, adult specimens being watched in shallow water among rocks off southern Bimini. They showed a pattern of horizontal stripes on the posterior two-thirds of the body, consisting of five light greenish-yellow stripes on a dark brown background. Closer examination revealed a number of regularly spaced, small, dark spots in this area as in the 38 mm. specimen. The anterior half of the body varied from a light tan to dark brown with some dull yellow spots above and behind the eye and occasionally there were about a dozen yellow lines on each side of the face, radiating from the mouth. Several dull yellow, wavy lines occurred on the lower part of the ventral flap. The white spot behind the second dorsal fin was always conspicuous in this phase of color-pattern and in addition a white spot on the mid-ventral line just behind the anal fin was usually noticeable. The first dorsal spine was a solid dark brown and the membrane behind a greenish-yellow. The



TEXT-FIG. 5. Sketches showing three different color pattern phases of *Cantherines pullus* (see text).

caudal fin varied from a light brown overcast with a dull greenish-yellow to a pale brownish-yellow. The pectoral fins were colorless and the second dorsal and anal fins colorless except for some orange on the proximal part of the membranes between the rays. This horizontally striped pattern phase is shown in Text-fig. 5 (top).

The spotted phase was first observed in an aquarium containing two adults (later dissected and found to be a male and a female). The male occasionally was observed to swim alongside the female, then somewhat in front of her, turn slightly on his side and point his nose downward at about a 45° angle. At this time the first dorsal spine was erected and quivered back and forth, and the membrane of the first dorsal fin became a brilliant sea green. The caudal fin was spread and the ventral flap, not appreciably expansible, was

extended to its maximum and became a bright peacock blue in color. The body retained some of the horizontally striped pattern previously described. These stripes, however, took on a purplish-blue hue and were overlaid with conspicuous orange spots. During close sidling the male sometimes nipped at the female, who then showed an instantaneous and trenchant color pattern change. The horizontal bands in some cases faded completely and on a much paler bluish background, vivid orange spots with small dark brown centers (corresponding to the arrangement of faint spotting seen in the striped phase) appeared over the posterior two-thirds of the body. The radiating facial lines and undulating lines on the ventral flap were more clearly delineated. Both male and female showed this spotted pattern phase when pulled out of water with a net, the male

in addition showing a bright blue color on the face between the yellow radiating lines. This color pattern phase (see Text-fig. 5—center) seemed to appear when the fish was highly excited, during fighting or what may have been courtship. The female in one case (113 mm.) contained bright green mature ova which were easily squeezed out by slight pressure on the abdomen. From all the other adult specimens, however, no eggs or sperm could be forced out and when dissected none had ripe gonads.

The third rather distinct color pattern was observed at night when a light was flashed on the resting fish (see Text-fig. 5—bottom) and was occasionally seen during the day when a fish was resting in a dark corner. At such times these fish appeared "off guard" and could be caught by hand, whereupon they quickly changed to the orange spotted phase. The color pattern of resting fish was a dark brown mottling on a tan background in some places forming vertical bands—two sharp bands on the tail, one connecting the eyes, one large irregular one on the middle of the body from a fork below the second dorsal fin onto the ventral flap, and another, forked above and below, connecting the posterior part of the base of the second dorsal fin with the base of the ventral fin. Six dark rings were regularly spaced on the first dorsal spine. The white spot behind the second dorsal fin, although obscured by lighter and more irregular color patterns, was nevertheless present in the spotted and vertically banded pattern phases.

On two occasions when these fish were chased with a net and cornered in a concrete tank having a sandy bottom, the fish lay on their sides and remained motionless when poked. Their color blanched except for small, irregular blotches and they so closely resembled the bottom of the tank that they could barely be detected. This blanching appeared to be a case of matching the background, since the typical fright reaction was a color change to the orange spotted phase already described. When placed in formalin, the body, tail and first dorsal fin became a uniform dark brown.

Alutera punctata

Jordan & Evermann (Agassiz?).²

Three adults (196, 197, and 264 mm.) were caught in traps. The smallest was a female from which mature ova were released when slight pressure was applied to its sides. The pale green eggs were sticky and demersal. Six young (47.7 to 66.4 mm.)³ were examined from a dredged collection made near the laboratory dock on October 27, 1948. The fin

² The three adult specimens described here are certainly distinct from *A. schoepfi* (Walbaum) and appear to be the same as the *A. punctata* described in Jordan & Evermann (1896-1900). Longley (Longley & Hildebrand, 1941) however, has pointed out certain discrepancies in the literature regarding this species. The proper identity at present is uncertain.

³ These are probably the young of *A. punctata* but are not distinguishable from those of *A. schoepfi* (Walbaum).

counts of these nine specimens were: D. 34-37, A. 36-40.

The pattern on the adults was usually that of large, dark patches forming six saddle marks across the back and blending to form a wide, irregularly oblique band and interrupted vertical bands on the sides. A number of round, black spots were usually present on the upper middle portion of the sides of the body. When the fish became frightened the dark patches faded and the spots became more numerous and covered a larger surface. A male was observed to "nose-down" before a female while strongly vibrating his first dorsal spine through an arc of about 100°, but no color change was noticed to take place at this time as in *C. pullus*.

Alutera scripta (Osbeck).

Five adults (414-513 mm.) caught on hook and line were kept alive in the outdoor pens. When swimming undisturbed the base color of the body was a light greenish-yellow with bright blue to purple dashes and dots running in broken horizontal lines. Irregular dark patches around the outline of the body (side view) were sometimes barely conspicuous while at other times they extended into irregular vertical bands. The vertical bands, as in *C. pullus*, were most noticeable at night when the fish were resting. The dorsal, anal and pectoral fins varied from colorless to yellow with yellow-brown rays. When the fish were frightened, the dark patches faded and round, dark spots appeared somewhat regularly spaced over the body.

Spheroides spengleri (Bloch).

Two specimens were dredged in shallow water near the laboratory dock, a 78 mm. female and a 130 mm. male. Both showed remarkable inflating powers. Dissection showed a well defined ring-like constriction separating the ventral expansible part of the stomach from the stomach proper, the same as the condition described for *Spheroides maculatus* (Breder & Clark, 1947).

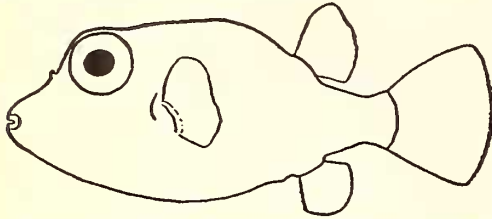
Spheroides marmoratus (Ranzani).

Eight adults, 123 to 198 mm. in standard length, were obtained from traps set in the bay during February. Four were males from which motile sperm was easily squeezed out and four were females with well developed ovaries containing immature ova. In all cases the left ovary was about one-third larger than the right. The stomach, as in *S. spengleri*, was divided by a ring-like constriction. The background color of these fish varied from a rather uniform dark greenish-brown to a sandy white with ruptive dark bands on the head and back. The pale reticulations over the body and the spotting on the lower sides barely showed in the lighter phases. The belly varied from white to bright yellow. Most of the time these fish remained resting on the bottom of their aquaria and when disturbed, burrowed into the sand by means of their pelvic bones in the manner described

by Parr (1927) until only the top of the head and eyes were exposed.

***Canthigaster rostratus* (Bloch).**

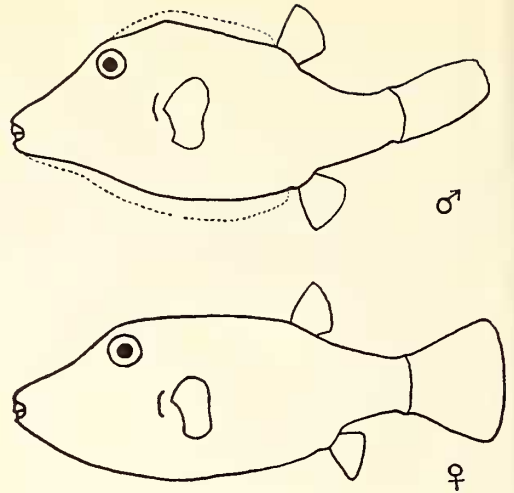
Three young specimens of 11, 13, and 16 mm. were caught by nets with floating *Sargassum*. When handled they showed a highly expansible belly region. An outline of the 16 mm. specimen, deflated, is shown in Text-fig. 6. Seven specimens (4.3 to 8.5 mm.) were found in plankton samples. Two adult females, 51 and 52 mm., and 21 adult males, 47 to 69 mm., were dredged near the laboratory dock. The males all showed an elevated point on the mid-dorsal line over the gill opening. The two females, like the young, lacked this character. Text-fig. 7 shows this difference in body form, which may be a secondary sex difference.



TEXT-FIG. 6. An outline sketch of a 16 mm. young *Canthigaster rostratus*.

A number of adults were observed in aquaria, handled and "tickled," but unlike the younger specimens they could not be induced to puff out to the remarkable extent which is so characteristic of most gymnodonts. There is developed, however, a unique modification in the use of the expansible skin which apparently involves a mechanism quite different from that of puffing. When startled by a moving object or when placed together for the first time, the males were usually observed to raise the loose skin of their bodies, forming prominent mid-dorsal and mid-ventral ridges as indicated on Text-fig. 7 (top). Fish established in an aquarium for several days showed this behavior less frequently, although when a new individual was introduced this behavior was again observed, quite often among all the fish when approaching each other. During this "ridge lifting" the fish usually turns slightly onto one side and the tail is turned either downwards or more often upwards. Sometimes only the ventral ridge is pushed out. Occasionally an apparently undisturbed fish was seen swimming or resting in an angular position, with tail upwards, and a slight ventral ridge showing (see Pl. II, Fig. 6). Dissection showed the presence of a puffing mechanism the same as described for *Canthigaster cinctus* (Clark, 1949) but superficial examination showed no special anatomical modification to account for the peculiar ridge-lifting phenomenon.

Occasionally adult specimens were seen with an irregularly brown mottled pattern, dark to light brown areas on a pale background, and showed little coloring. More often, however, the following color pattern is



TEXT-FIG. 7. Diagrammatic outlines of a male and female *Canthigaster rostratus*. The male is shown in the curved body position which it frequently assumes, especially when the mid-dorsal and mid-ventral ridges (indicated with dotted lines) are raised.

seen: the upper part of the body is darker than the lower part and often a dark brown spot is evident just below the anterior base of the dorsal fin. The dorsal and ventral margins of the caudal fin are a dark brown. Sometimes two dark brown lines show on each side of the body, a more prominent upper line extending from above and behind the gill opening to the dorsal base of caudal fin and a shorter line starting some distance behind lower part of pectoral fin to ventral base of caudal fin. These two lines usually terminate in dark spots at base of caudal fin. There are radiating lines from the eye, which vary in number from four to nine and are limited to anterior, ventral and posterior part of rim of the eye, none crossing the mid-dorsal line of the head. These lines—and other lines and spots which vary considerably over the head, center and posterior parts of the body—are a purplish-blue. The base color on the side of the head is mainly a bright golden orange which fades to a dull olive yellow on the belly and lower sides of the body. The caudal and dorsal fin rays are bright orange. The pectoral and anal fins are colorless except for a pale orange yellow hue at their bases.

***Diodon hystrix* (Linnaeus).**

Two young specimens of 44 and 140 mm. were caught in a dredge near the laboratory dock and one 62 mm. specimen was collected from floating *Sargassum* off southern Bimini. Four adults, 362 to 420 mm., were in the laboratory's live collection. In all the specimens the frontal spines were unmistakably shorter than the postpectorals and the caudal peduncle, dorsal and anal fins were not hidden when the fish were inflated. Adults were seen on several occasions when diving with goggles among coral heads off southern Bimini. They would lie very still in small crevices

until closely approached and then dart off to another hiding place.

Chilomycterus antillarum Jordan & Rutler.

Three specimens, 108, 118, and 120 mm., were dredged near the laboratory dock. Hexagonal reticulations, coverings the dorsal and lateral regions of the body, were distinct in the various color changes of living specimens and also in fishes preserved in formalin.

OTHER PLECTOGNATH SPECIES.

Several other species collected at Bimini were examined from the live collection:

6 <i>Balistes carolinensis</i> Gmelin	17.1 to 250 mm.
6 <i>Canthidermis sufflamen</i> (Mitchill)	362 to 468 mm.
14 <i>Rhinesomus bicaudalis</i> (Linnaeus)	203 to 320 mm.
18 <i>Acanthostracion quadricornis</i> (Linnaeus)	164 to 276 mm.
12 <i>Lactophrys trigonus</i> (Linnaeus)	116 to 338 mm. ⁴

SUMMARY.

Incidental notes on the behavior and/or morphology of *Balistes vetula*, *Melichthys piceus*, *Monacanthus ciliatus*, *M. tuckerii*, *Cantherines pullus*, *Alutera punctata*, *A. scripta*, *Spheroides spengleri*, *S. marmoratus*, *Canthigaster rostratus*, *Diodon hystrix* and *Chilomycterus antillarum* are reported. Detailed descriptions are included of the unusual head-standing aggressive behavior in *M. ciliatus*, the color changes of *C. pullus*, and the peculiar ridge-lifting phenomenon in *C. rostratus*. Sexual dimorphism in *M. ciliatus* and *M. tuckerii* is discussed along with problems concerned with the taxonomy of *M. ciliatus*.

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⁴ The writer examined two specimens of this species in which the carapace was completely fused behind the dorsal fin just anterior to the free scale on the caudal peduncle—an atypical character for this species.

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EXPLANATION OF THE PLATES.

PLATE I.

- FIG. 1. A male *Monacanthus ciliatus* with the ventral flap fully expanded.
FIG. 2. A male *Mocanathus ciliatus* in the "head stand" position.
FIG. 3. *Canthigaster rostratus*. Male on left exhibits prominent mid-dorsal and mid-ventral ridges.

PLATE II.

- FIG. 4. *Canthigaster rostratus*. Male on right shows mid-dorsal and mid-ventral ridges.
FIG. 5. *Canthigaster rostratus*. Front view of mid-ventral ridge.
FIG. 6. *Canthigaster rostratus*. Swimming slowly in the angular position described in text. The mid-ventral ridge shows slightly.